

# A Note on Gametogenesis in the Oyster Drills, *Urosalpinx cinerea* (Say) and *Eupleura caudata* (Say)

BY

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(2 Plates)

## INTRODUCTION

THE OYSTER DRILLS, *Urosalpinx cinerea* (Say, 1822), found in the coastal waters of North America and the British Isles, and *Eupleura caudata* (Say, 1822), found from Cape Cod to Florida, are small, ubiquitous marine gastropods. Along with the sea star, *Asterias forbesi* (Dessor, 1848), they are the principal oyster predators in Long Island Sound. Several investigators have studied the life history and behavior of these predators to obtain the basic biological information necessary to develop efficient and economical control procedures. Despite an abundance of literature resulting from these studies, little is known about the gametogenesis of *U. cinerea* and *E. caudata*.

Most studies of drill reproduction have been made solely on the basis of oviposition as the principal indicator of the time and intensity of spawning (FEDERIGHI, 1931; GALTSOFF *et al.*, 1937; COLE, 1942; STAUBER, 1943; LOOSANOFF & DAVIS, 1950; ANDREWS, 1956; HANCOCK, 1959; MACKENZIE, 1961; MANZI, 1970). Whereas these studies have defined the beginning and duration of spawning and have shown the effects of temperature and salinity on egg capsule deposition, they do not consider gametogenesis in either of these species. Our study has, therefore, elucidated gametogenesis in *Urosalpinx cinerea* and *Eupleura caudata*.

## METHODS AND MATERIALS

Oyster drills were obtained from bottom material brought to the surface by a standard oyster dredge during com-

mercial operations. All animals were collected in Long Island Sound in the vicinity of the Norwalk Islands, Norwalk, Connecticut, an area extensively used for farming oysters and characterized by relatively shallow depths and moderate currents. The drills were separated by species in the laboratory, live-sexed using the method described by HARGIS (1957) and placed in 60-liter capacity fiberglass aquaria. The aquaria were supplied with a continuous flow of sea water (8 liters per minute) at ambient temperature (0.5° to 22.0° C) and salinity (27 ± 1‰). Clusters of young oysters were added to each aquarium to provide food for the drills during the holding periods.

Ten drills of each species (5 females and 5 males) were removed from each supply on alternate weeks from April 1968 to June 1969, and placed in Lillie's decalcifier fixative (HUMASON, 1962) for 24 hours. Following standard histological techniques the gonad was dissected out, dehydrated in alcohol, cleared in xylene and embedded in paraffin. Gonad tissues were sectioned at 7 $\mu$  with a rotary microtome, stained with Delafield's hematoxylin and counterstained with eosin. The sections were examined with a light microscope and photomicrographs of the various stages of gametogenesis were taken at  $\times 100$  and  $\times 430$  magnification.

## RESULTS AND DISCUSSION

The gonad of *Urosalpinx cinerea* and *Eupleura caudata*, as in all monotocardians, is single and overlies the mid-gut gland and terminal visceral coils. Gonad color varies considerably (white, yellow and orange) and sex determination by color is completely unreliable. Gonad size did not change appreciably throughout the period of this study.

The gonad sections collected over the 14 months were remarkably similar and a distinct gametogenic progression was not discernible in either adult males or females of

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both species. Gonadal development in these drills appeared to be a continuous process with no well-defined stage of inactivity. Serial sections made at any time of the year revealed areas of active, ripe and quasi-spent gonadal tissue. Temperature, which ranged from 0.5° to 22.0° C over the 14-month sampling period, appeared to have little effect on gonadal condition.

Spermatogenesis in *Urosalpinx cinerea* and *Eupleura caudata* was similar. In all male gonad sections studied no true inactive or resting stage was observed in any area of the gonad. Areas which were defined as active (Figures 1 and 2) exhibited all the stages of spermatogenesis. Along the basal membrane of the alveoli numerous proliferating primary spermatocytes were present. In the centers of the alveoli great numbers of spermatids produced dark linear bands. Areas of the gonads characterized as ripe (Figures 3 and 4) contained large masses of spermatozoa in enlarged follicles. The tails of the spermatozoa were arranged in spirals from the center of the lumina outward. Partially spawned areas (Figures 5 and 6) of the gonad were distinguished by the presence of relatively few spermatogonia and large spaces in the lumina of the follicles. Although male gonads, as a whole, did not show any distinct, progressive stages of spermatogenesis, a periodicity of gamete production was observed. More areas of the gonad were ripe in late spring and early summer (water temperature 17.0° to 20.1° C) than at any other time. There also appeared to be an increase in the total amount of gonadal tissue in the partially spent and active stages during late summer and early fall (water temperature 18° to 15° C).

Oogenesis in *Urosalpinx cinerea* and *Eupleura caudata* was also very similar. No true inactive or resting stage

in the reproductive cycle of either drill species was observed. Distinct areas of gonadal tissue in either the completely active, ripe or spent condition were observed only rarely. The female gonad appeared to be in a constant state of activity with both ripe and partially spent follicles (Figures 7, 8, 9 and 10) throughout the entire gonad. Female gonads revealed the same periodicity of activity described for males, but to a lesser extent. Gonad sections indicated a slight increase in the number of follicles in the ripe condition in late spring and early summer and a proportional decrease of ripe follicles in the fall. Aside from this slight rhythm no apparent indication of the natural spawning period was observable. Previous studies have shown that females of both species have the ability to store viable sperm (STAUBER, 1943; HARGIS & MACKENZIE, 1961; MACKENZIE, 1961) and this ability was observed in many of the gonad sections examined in this study (Figures 11 and 12). Pockets of stored sperm were observed in 32.9% of the females sectioned.

## SUMMARY

1. Spermatogenesis in *Urosalpinx cinerea* and *Eupleura caudata* appeared to be a continuous process with no seasonally progressive stages and no clearly defined inactive period.
2. Oogenesis in both species also indicated continuous gonadal activity with no clearly defined inactive stage.
3. Males and females of both species revealed a marked periodicity in the amounts of viable gametes available. These amounts increased in late spring and early summer and decreased in the fall coincidental with the natural spawning period.

## Plate Explanation

Section of Gonad Tissue of Male *Urosalpinx cinerea* and *Eupleura caudata*

Figure 1: Active phase of spermatogenesis of *Urosalpinx cinerea* (× 430)

Figure 2: Active phase of spermatogenesis of *Eupleura caudata* (× 100)

Figure 3: Ripe *Urosalpinx cinerea* (× 100)

Figure 4: Ripe *Eupleura caudata* (× 100)

Figure 5: Partially spawned *Urosalpinx cinerea* (× 430)

Figure 6: Spent *Eupleura caudata* (× 430)

## Plate Explanation

Section of Gonad Tissue of Female *Urosalpinx cinerea* and *Eupleura caudata*

Figure 7: Ripe *Urosalpinx cinerea* (× 430)

Figure 8: Ripe *Eupleura caudata* (× 430)

Figure 9: Ripe and spent stages of *Urosalpinx cinerea* (× 100)

Figure 10: Ripe and spent stages of *Eupleura caudata* (× 100)

Figure 11: Stored sperm in *Urosalpinx cinerea* (× 430)

Figure 12: Stored sperm in *Eupleura caudata* (× 100)

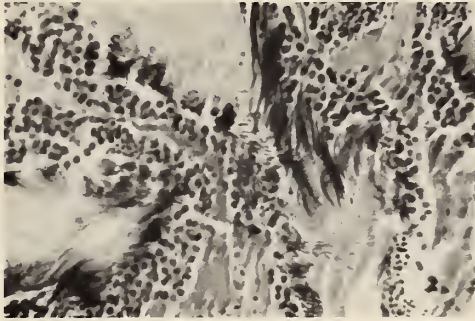


Figure 1

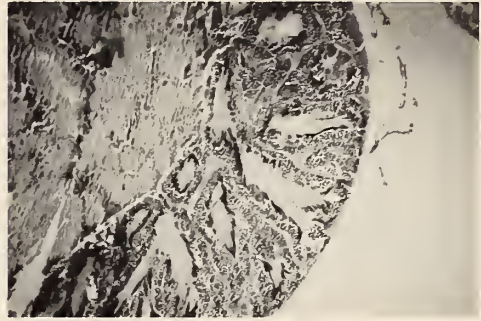


Figure 2

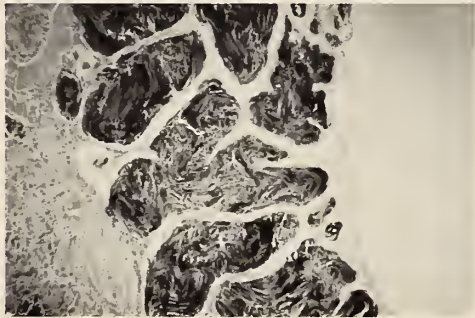


Figure 3

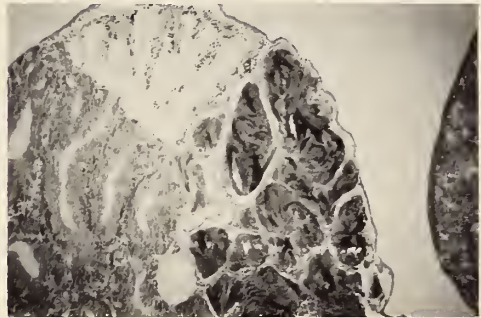


Figure 4

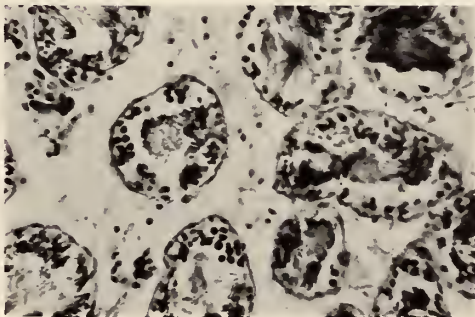


Figure 5

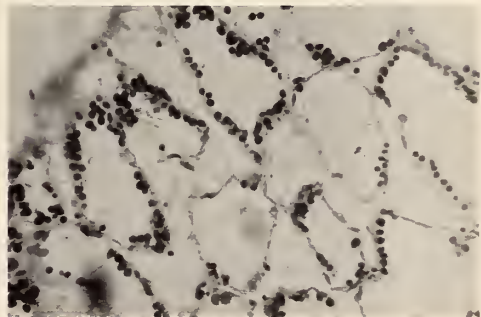


Figure 6